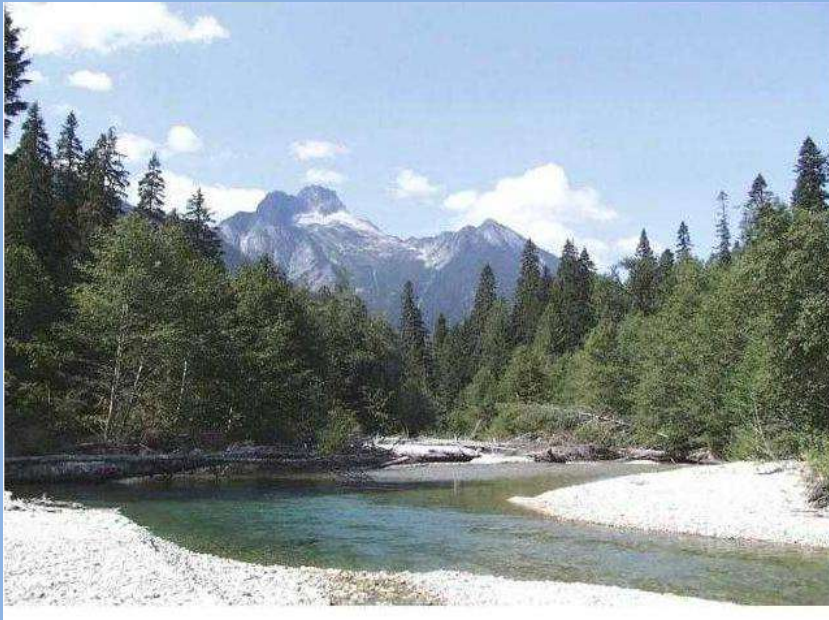


Ecological Context for the North Pacific LCC



Andrea Woodward

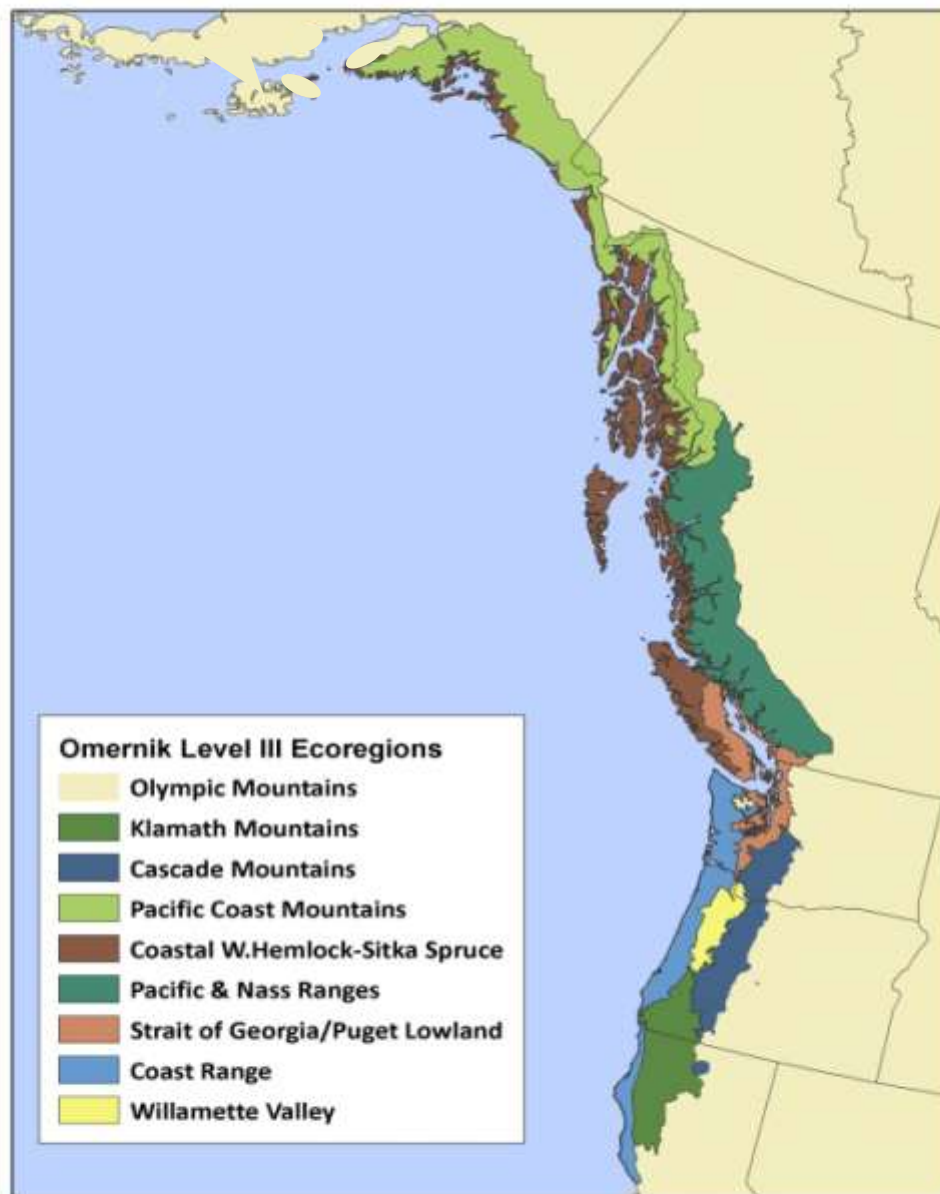
Audrey Taylor

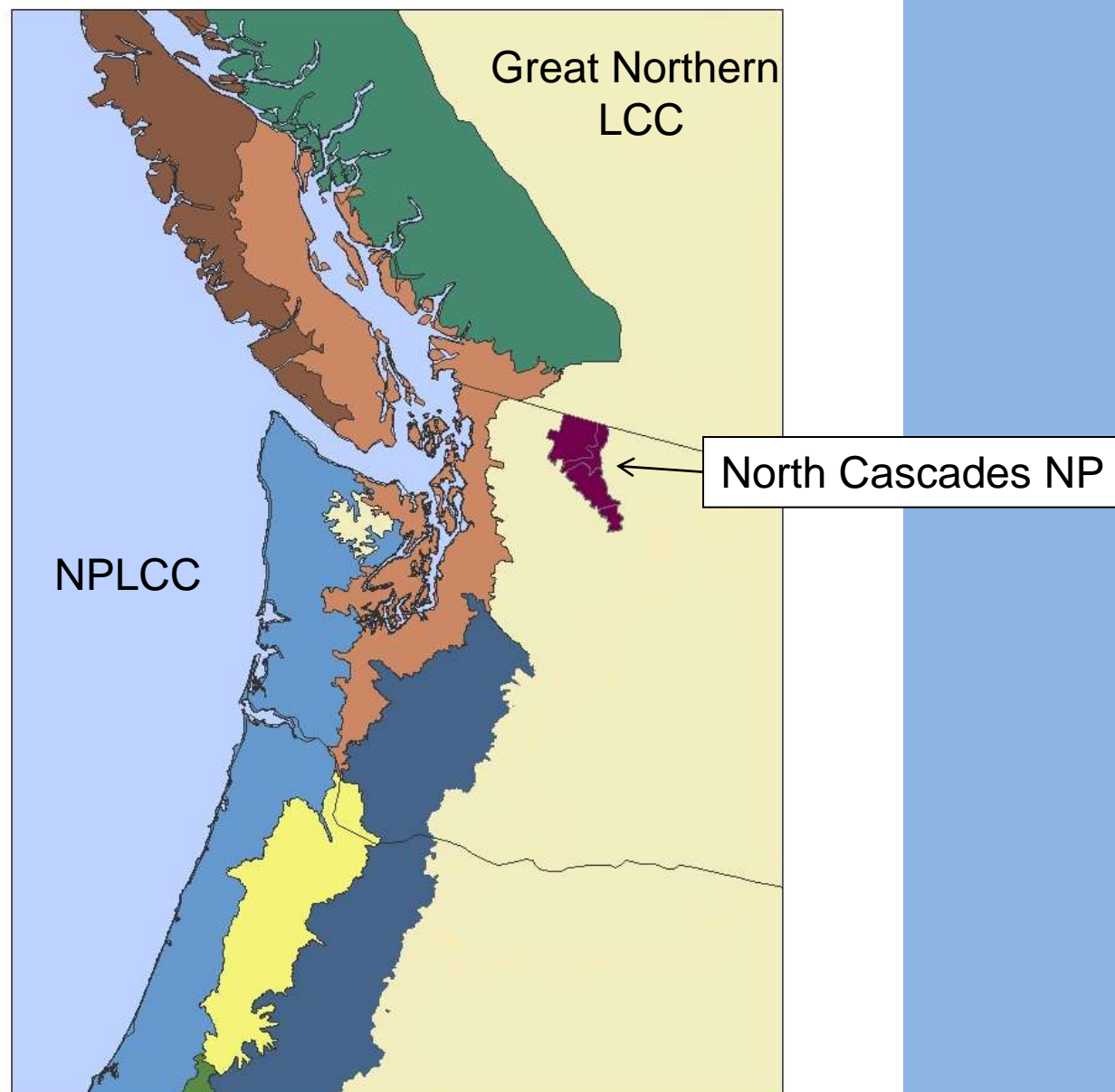
Anne Weekes

USGS Forest & Rangeland
Ecosystem Science Center

Landscape Conservation Cooperatives. Given the broad impacts of climate change, management responses to such impacts must be coordinated on a landscape-level basis. For example, wildlife migration and related needs for new wildlife corridors, the spread of invasive species and wildfire risks, typically will extend beyond the borders of National Wildlife Refuges, BLM lands, or National Parks. Additionally, some bureau responsibilities (e.g., Fish and Wildlife Service migratory bird and threatened and endangered species responsibilities) extend nationally and globally. **Because of the unprecedented scope of affected landscapes, Interior bureaus and agencies must work together, and with other federal, state, tribal and local governments, and private landowner partners, to develop landscape-level strategies for understanding and responding to climate change impacts.** Interior bureaus and agencies, guided by the *Energy and Climate Change Council*, will work to stimulate the development of a network of collaborative “Landscape Conservation Cooperatives.” ...

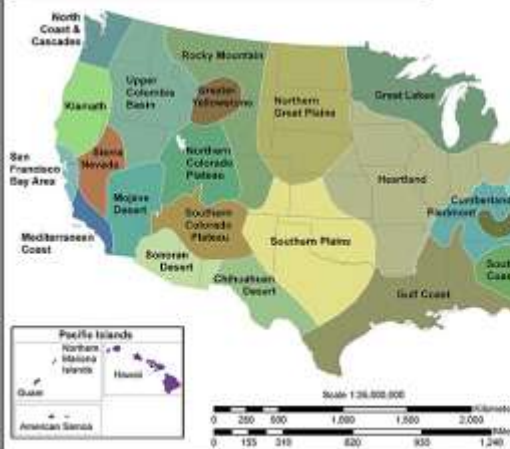
from Secretarial Order 3226 – Ken Salazar (2009)





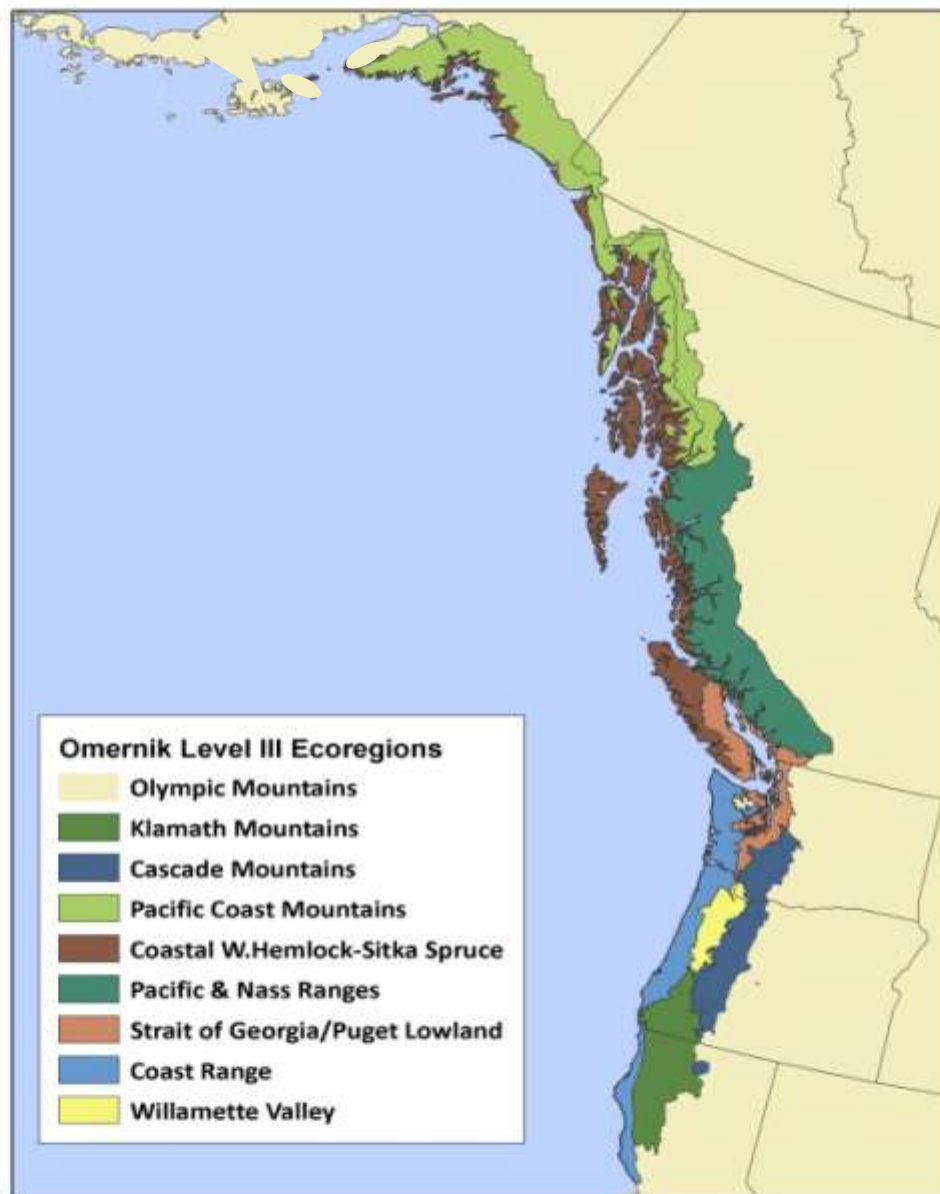
National Park Service Inventory & Monitoring Program Networks

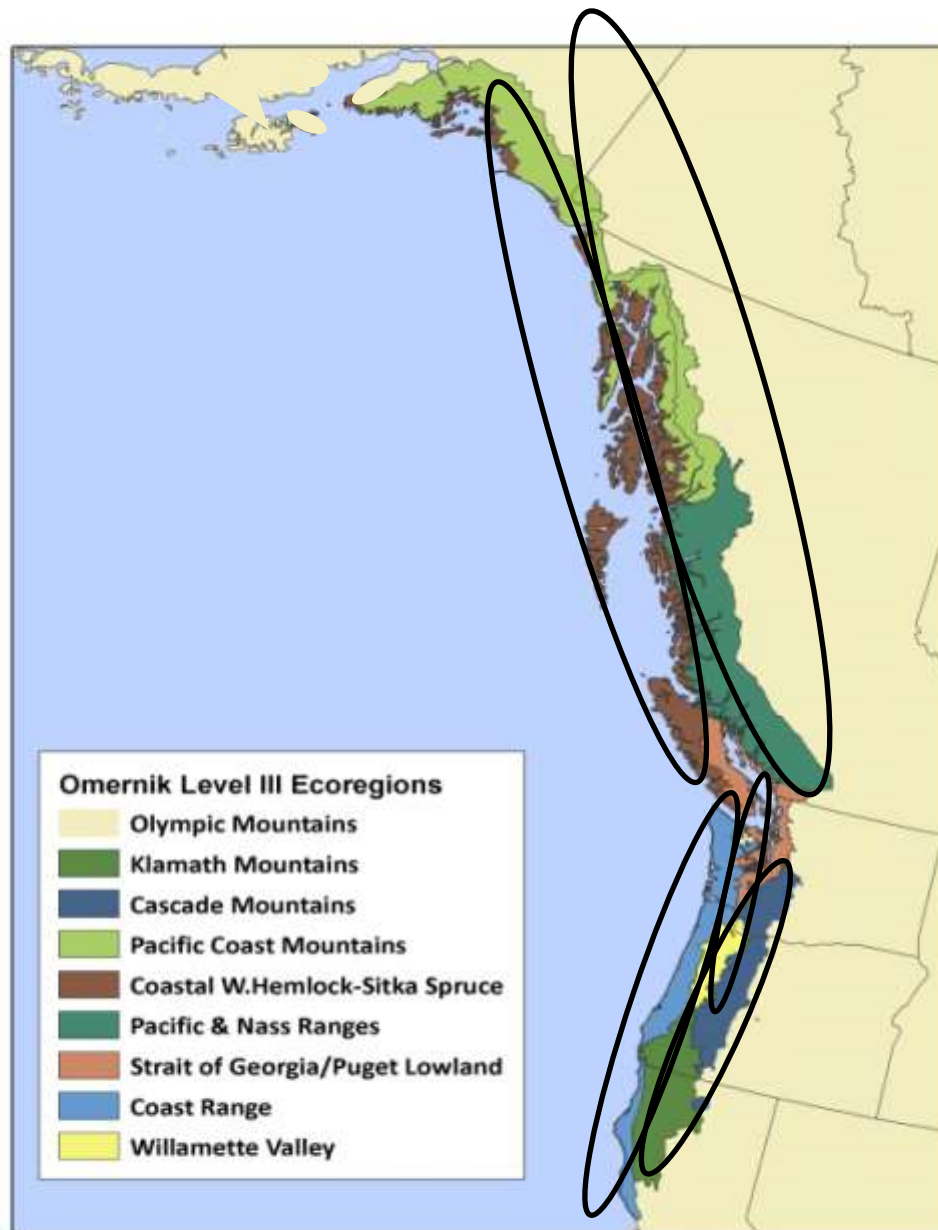
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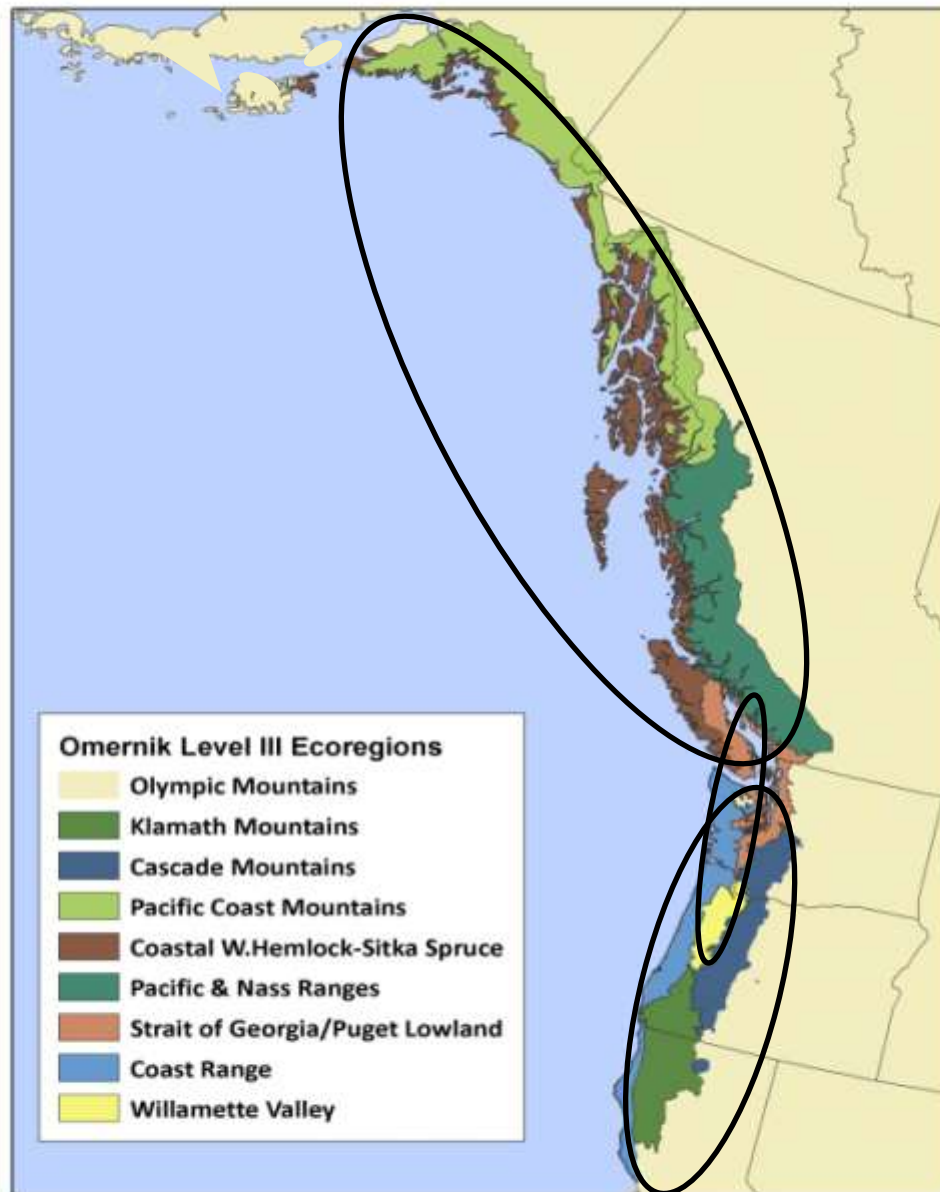


Conceptual Models

- Created for a specific purpose
- Often a graphic visualization
- Used as communication tools
- Create a shared vision





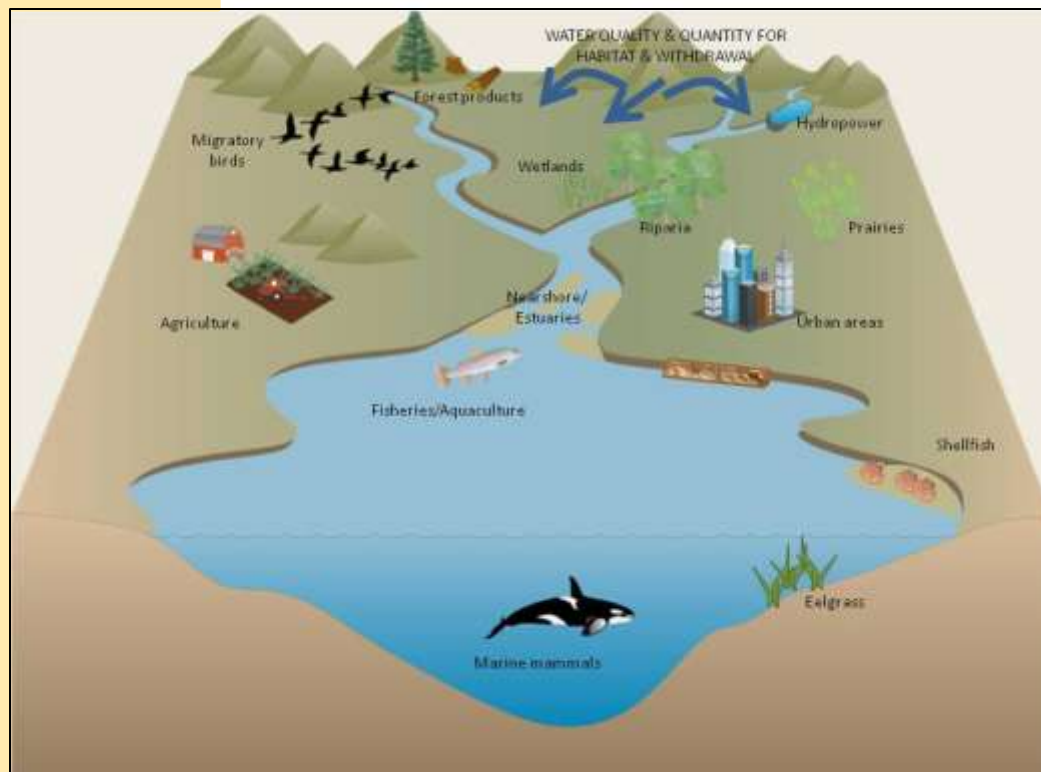
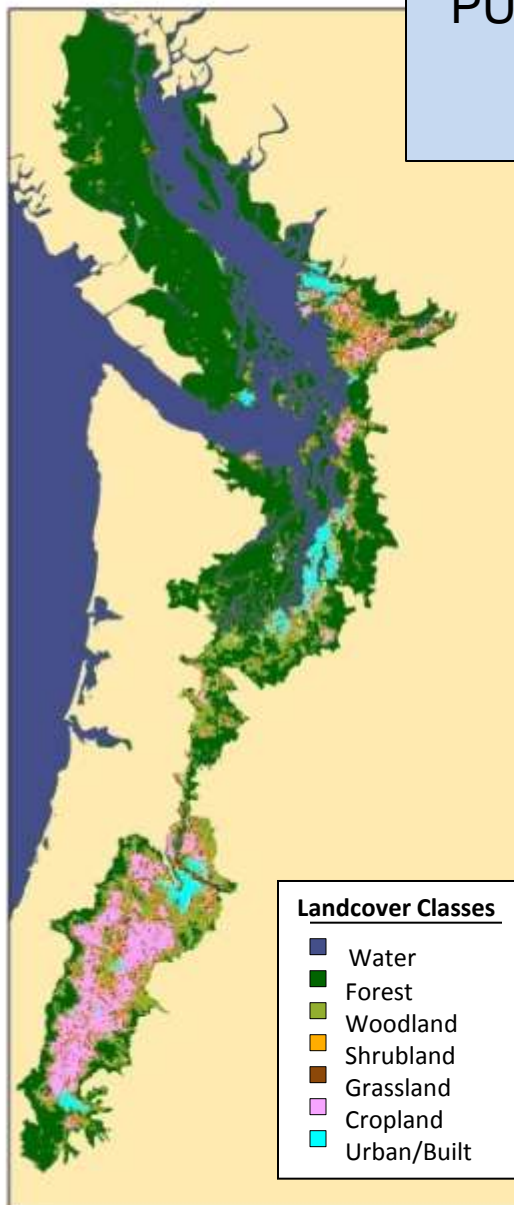


PUGET-GEORGIA BASIN LOWLANDS & WILLAMETTE VALLEY

Valued Human, Ecological and Cultural Resources	Existing Stressors	Current & Potential Climate Change Impacts
<ul style="list-style-type: none"> • Human resource needs: <ul style="list-style-type: none"> ○ Water quality & quantity (residential, agricultural, industrial, commercial, recreational use) ○ Forest products ○ Hydropower ○ Agriculture ○ Fisheries/aquaculture • Vulnerable habitats: <ul style="list-style-type: none"> ○ Prairies ○ Freshwater wetlands ○ Riparian areas ○ Forests & woodlands ○ Nearshore, estuary, and river delta habitats, esp. eelgrass beds • Vulnerable species: <ul style="list-style-type: none"> ○ Anadromous fish ○ Marine mammals ○ Shellfish ○ Forage fish ○ Migratory birds 	<ul style="list-style-type: none"> • Changes in land cover/land use: <ul style="list-style-type: none"> ○ Increased water withdrawal (urban, agriculture, mining) ○ Larger floods/aggradation/channel capacity ○ Water quality/turbidity/increased fine sediment loads ○ Habitat alteration • Urbanization: <ul style="list-style-type: none"> ○ Increased impermeable surface/ heat islands ○ Storm water, waste water pollutants ○ Emissions – particulates, POPS • Shoreline armoring & development 	<ul style="list-style-type: none"> • Hydrologic regime changes: <ul style="list-style-type: none"> ○ Sediment dynamics changes in rivers, estuaries and shorelines • Increased atmospheric temperatures: <ul style="list-style-type: none"> ○ Extreme/unpredictable weather ○ Plant & animal stress ○ Forest disturbance increase • Sea level rise (exacerbated by subsidence in Puget Sound): <ul style="list-style-type: none"> ○ Coastal flooding & salt water intrusion ○ Permanent inundation (including inhabited tribal land) • Ocean acidification

- Puget Sound Partnership. 2010. State of the Sound Report. Publication no. PSP09-08. Puget Sound Partnership.
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- Baker, J. P., D.H. Hulse, S.V. Gregory, D.White, J. Van Sickle, P.A. Berger, D. Dole, and N.H. Schumaker. 2004. Alternative futures for the Willamette River basin, Oregon. Ecological Applications 14:313-324.
- Transboundary Georgia Basin-Puget Sound Environmental Indicators Working Group. 2002. Georgia Basin-Puget Sound Ecosystem Indicators Report. GB Ecosystem Initiative Publications No. EC/GB-01-034. Environment Canada.
- Fraser, D.A., J.K. Gaydos, E. Karlsen and M.S. Rylko. 2006. Collaborative science, policy development and program implementation in the transboundary Georgia Basin/Puget Sound ecosystem. Environmental Monitoring and Assessment 113:49-69.
- <http://cses.washington.edu/cig/pnwc/ci.shtml>

PUGET-GEORGIA BASIN LOWLANDS & WILLAMETTE VALLEY



ALASKA-BRITISH COLUMBIA COAST

Valued Human, Ecological and Cultural Resources	Existing Stressors	Current & Potential Climate Change Impacts
<ul style="list-style-type: none"> Human resource needs: <ul style="list-style-type: none"> Forest products Recreation and tourism Fisheries/aquaculture Metals and minerals Hydroelectric power Subsistence & personal use hunting Cultural resources Vulnerable habitats: <ul style="list-style-type: none"> Coastal old-growth forest Riparian areas Karst and caves Nearshore, estuary, & river delta habitats, esp. eelgrass beds Vulnerable species: <ul style="list-style-type: none"> Bird & mammal species requiring large tracts Isolated populations of birds, mammals and fish Marine mammals Forage fish Coldwater species 	<ul style="list-style-type: none"> Timber harvest: <ul style="list-style-type: none"> Habitat fragmentation & decrease Salmon habitat degradation Subsistence species loss Development (incl. for transportation): <ul style="list-style-type: none"> Habitat fragmentation Fish passage blockage Fish & wildlife consumption increase Wetland and nearshore habitat alteration or loss Contaminants Hydroelectric projects <ul style="list-style-type: none"> Hydrology alteration Fish passage impediments Alternative energy (currents & tidal) Introduced pathogens: <ul style="list-style-type: none"> Fish & wildlife population and habitat decrease Air & water pollution (from economic activity) 	<ul style="list-style-type: none"> Hydrologic regime changes: <ul style="list-style-type: none"> Longer ice/snow-free season Snowpack depth changes Increased atmospheric temperatures: <ul style="list-style-type: none"> Forest pathogen distribution increased Sea level rise (mitigated by isostatic rebound): <ul style="list-style-type: none"> Shoreline erosion Estuary and aquifer salinity increases Coastal flooding and inundation Ocean acidification Depth of ocean stratification

•D. Demarchi, J. Nelson, K. Kavanagh, M. Sims, G. Mann. 1999. British Columbia mainland coastal forest (NA0506). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

•D. DellaSala, L. Craighead, and R. Hagenstein. 1999. Northern Pacific coastal forest (NA0520) and Central British Columbia mountain forest (NA0509). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

•<http://www.cics.uvic.ca/climate/change/bcimpact.htm>

ALASKA-BRITISH COLUMBIA COAST

Landcover Classes

- Water
- Forest
- Woodland
- Shrubland
- Grassland
- Cropland
- Urban/Built



ALASKA-BRITISH COLUMBIA MOUNTAINS

Valued Human, Ecological and Cultural Resources	Existing Stressors	Current & Potential Climate Change Impacts
<ul style="list-style-type: none"> Human resource needs: <ul style="list-style-type: none"> Metals and minerals Electric power (hydro-, gas/oil, wind) Forest products Subsistence/personal use hunting & gathering Recreation & tourism Vulnerable habitats: <ul style="list-style-type: none"> Coastal old-growth forest Subalpine forest Alpine tundra Eastern slope/Nass Basin forest Riparian areas Mountain lakes Vulnerable species: <ul style="list-style-type: none"> Bird & mammal species requiring large tracts Isolated populations of birds, mammals and fish Coldwater and mountain species Anadromous fish 	<ul style="list-style-type: none"> Timber harvest and mining: <ul style="list-style-type: none"> Habitat fragmentation & decrease Salmon habitat degradation Development (including for transportation): <ul style="list-style-type: none"> Habitat fragmentation Fish passage blockage Fish & wildlife consumption increase Wetland alteration or loss Contaminants Hydroelectric projects <ul style="list-style-type: none"> Hydrology alteration Fish passage impediments Introduced pathogens: <ul style="list-style-type: none"> Fish & wildlife population and habitat decrease 	<ul style="list-style-type: none"> Hydrologic regime changes: <ul style="list-style-type: none"> Glacier melt Ice/snow-free season changes Snowpack depth changes Soil water storage changes (drying of muskeg) Increased atmospheric temperatures: <ul style="list-style-type: none"> Forest pathogen distribution increased Changes in plant community distribution <ul style="list-style-type: none"> Alpine replaced by forest Yellow cedar decline Wetland community decline

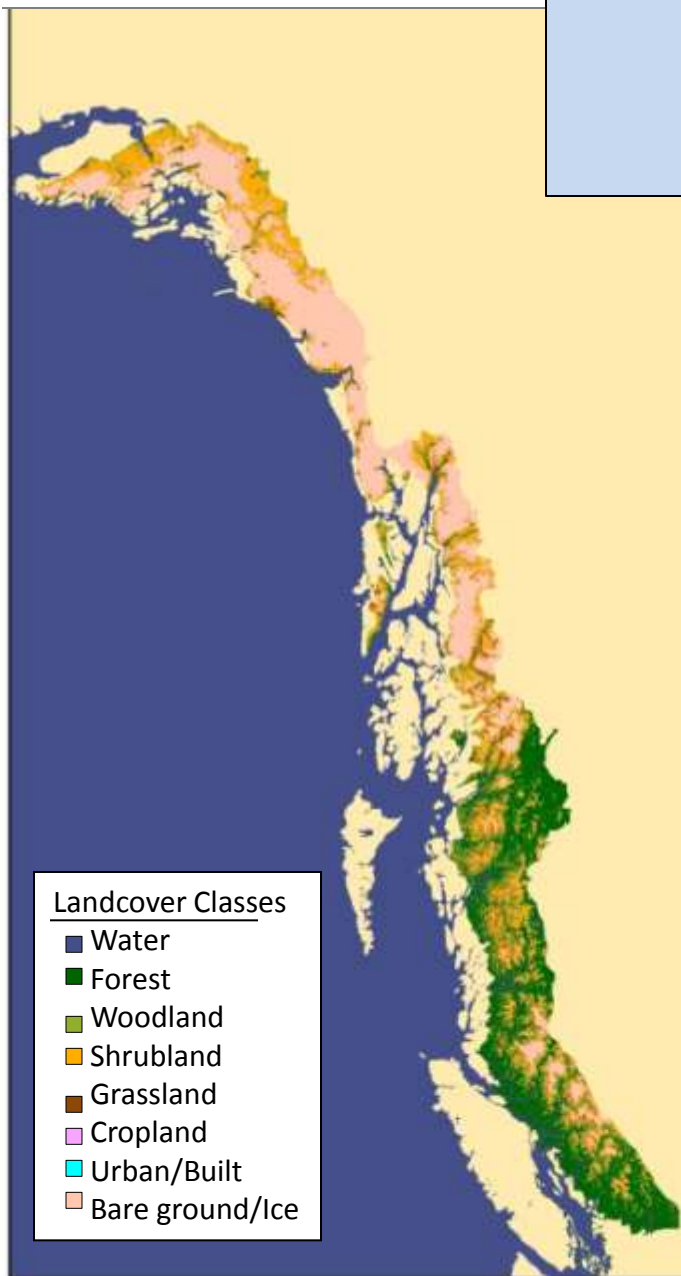
•Demarchi, J. Nelson, K. Kavanagh, M. Sims, G. Mann. 1999. British Columbia mainland coastal forest (NA0506) and Central British Columbia mountain forest (NA0509). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

•R. Hagenstein, T. Ricketts, L. Craighead, J. Peepre, K. Kavanagh, M. Sims, G. Mann. 1999. Pacific Coastal Mountain icefields and tundra (NA1117). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

•http://www.fakr.noaa.gov/npfmc/misc_pub/NorthernEconomics/Southcentral%20Alaska%20Profile.pdf



ALASKA-BRITISH COLUMBIA MOUNTAINS



Landcover Classes

- Water
- Forest
- Woodland
- Shrubland
- Grassland
- Cropland
- Urban/Built
- Bare ground/Ice



KLAMATH-OLYMPIC-CASCADE MOUNTAINS

Valued Human, Ecological and Cultural Resources	Existing Stressors	Current & Potential Climate Change Impacts
<ul style="list-style-type: none"> Human resource needs: <ul style="list-style-type: none"> Water quality & quantity (urban use, agriculture) Forest products Fisheries Hydroelectric power Recreation Vulnerable habitats <ul style="list-style-type: none"> Areas of unusually high biodiversity (e.g., “Klamath Knot”) Forests & woodlands Vulnerable species: <ul style="list-style-type: none"> Coldwater & mountain species Forest T&E species Anadromous fish 	<ul style="list-style-type: none"> Ground disturbance – timber harvest, road building, mining <ul style="list-style-type: none"> Erosion Sedimentation Water quality Fire suppression <ul style="list-style-type: none"> Increased vulnerability to future fires Water diversions for agriculture and hydropower Hatchery effects 	<ul style="list-style-type: none"> Hydrologic regime changes: <ul style="list-style-type: none"> Longer ice/snow-free season Decreased snowpack depth Increased atmospheric temperatures: <ul style="list-style-type: none"> Plant & animal stress Forest fire increase Changes in plant community distribution: <ul style="list-style-type: none"> Endemic conifer community decline in Klamath-Siskiyou region Alpine replaced by forest

•Olson, D., R. Noss, G. Orians, J. Stritholt, C. Williams, and J. Sawyer. 1999. Klamath-Siskiyou forest (NA0516). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

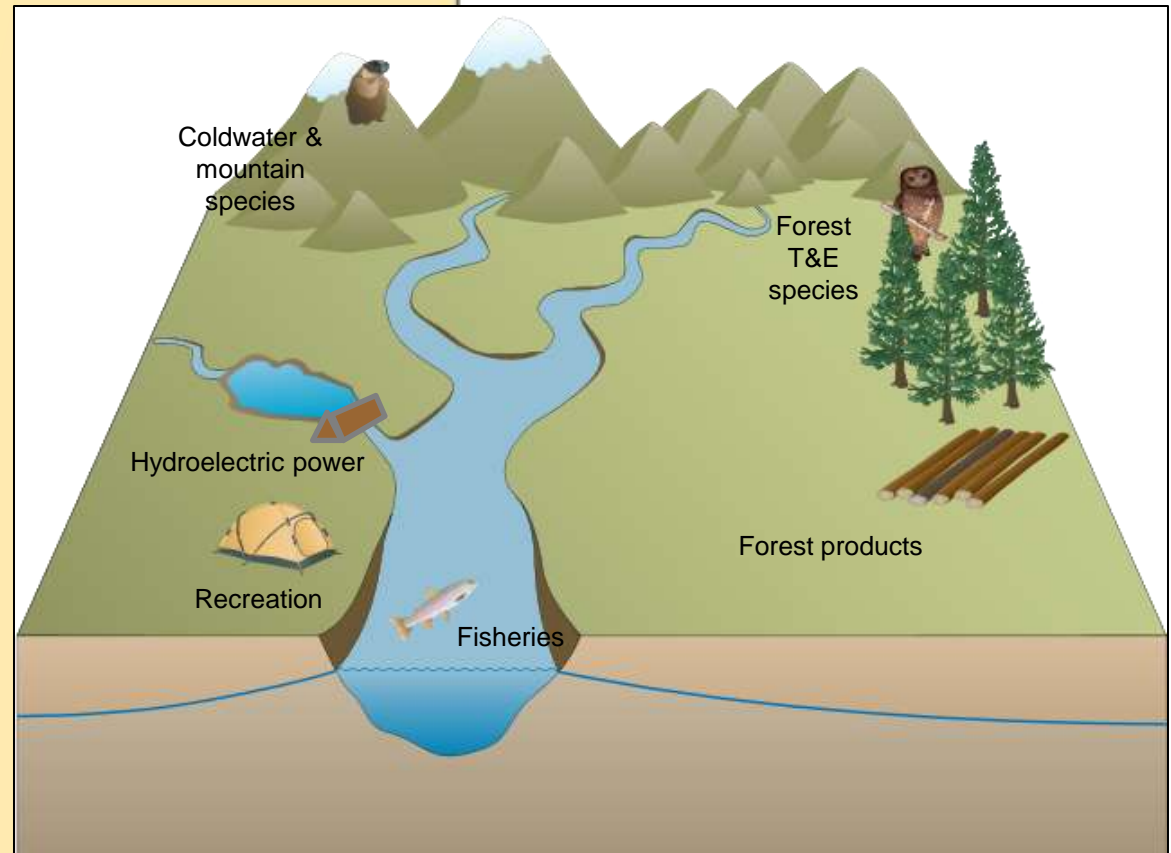
•DellaSala, D., J. Stritthold, R. Noss, and G. Orians. 1999. Central and southern Cascades (NA0508). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

•Damschen, E.I., S. Harrison, and J.B. Grace 2010. Climate change effects on an endemic-rich flora: resurveying Robert H. Whittaker’s Siskiyou sites (Oregon, USA). Ecology 91:3609-3619/

•http://www.mkwc.org/programs/firefuels/Klamath%20Fire%20Symposium/index_KFES.htm



KLAMATH-OLYMPIC-CASCADE MOUNTAINS

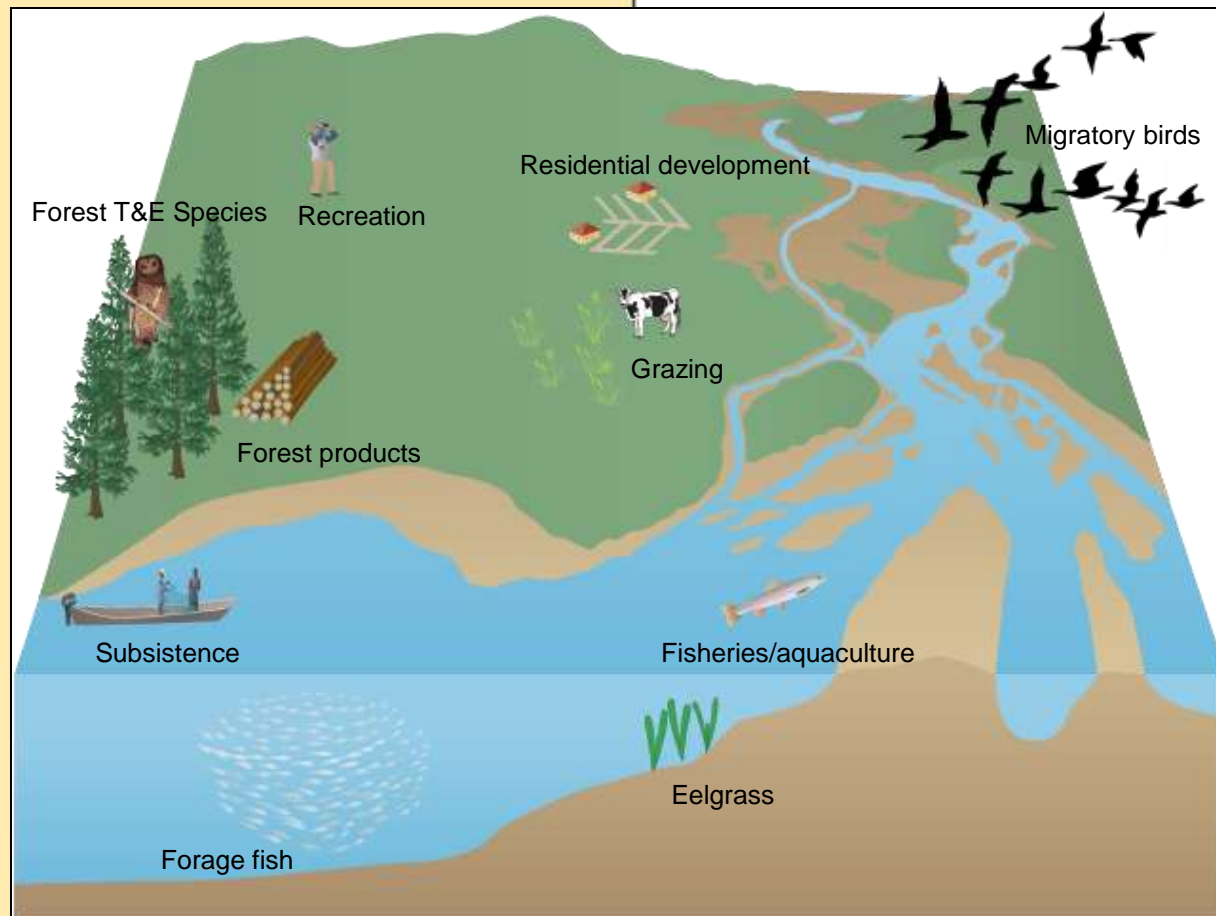


WASHINGTON-OREGON-NORTHERN CALIFORNIA COAST

Valued Human, Ecological and Cultural Resources	Existing Stressors	Current & Potential Climate Change Impacts
<ul style="list-style-type: none"> • Human resource needs: <ul style="list-style-type: none"> ○ Forest products ○ Fisheries/aquaculture ○ Recreation ○ Grazing ○ Subsistence, cultural, archeological • Vulnerable habitats: <ul style="list-style-type: none"> ○ Coastal forests (including Redwoods) ○ Coastal prairies ○ Nearshore, estuary, and beach/dune habitats, esp. eelgrass beds • Vulnerable species: <ul style="list-style-type: none"> ○ Forest T&E species ○ Migratory birds ○ Anadromous fish ○ Forage fish 	<ul style="list-style-type: none"> • Development & associated access: <ul style="list-style-type: none"> ○ Water system demand increase ○ Shoreline infrastructure ○ Impervious surface increase • Timber harvest: <ul style="list-style-type: none"> ○ Habitat loss & fragmentation ○ Salmon habitat degradation • Exotic species invasions • Fire suppression 	<ul style="list-style-type: none"> • Hydrologic regime changes: <ul style="list-style-type: none"> ○ Sediment dynamics changes in estuaries, rivers, and shorelines • Increased atmospheric temperatures: <ul style="list-style-type: none"> ○ Forest fire increase ○ Forest pathogen distribution increased ○ Plant & animal stress • Sea level rise (exacerbated by subsidence along N OR coast): <ul style="list-style-type: none"> ○ Shoreline erosion ○ Estuary and aquifer salinity increases ○ Coastal flooding and inundation • Ocean acidification

- Noss, R., G. Strittholt, G. Orians, J. Adams, K. Kavangh, M. Sims, and G. Mann. 1999. Central Pacific coastal forest (NA0510). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.
- Olson, D. and J. Sawyer. 1999. Northern California coastal forests (NA0519). In: Ricketts, T., E. Dinerstein, D. M. Olson, C. J. Louck et al., Terrestrial Ecoregions of North America: A Conservation Assessment. World Wildlife Fund, Island Press.

WASHINGTON-OREGON-NORTHERN CALIFORNIA COAST



Landcover Classes

- Water
- Forest
- Woodland
- Shrubland
- Grassland
- Cropland
- Urban/Built



COMMON THEMES ACROSS NPLCC

Valued human, ecological, and cultural resources

- Forest products
- Old growth forests
- Freshwater quality, timing, availability
- Anadromous fish populations
- Migratory birds
- Carbon sequestration capacity
- Cultural resources
- Habitat connectivity
- Near shore / coastal / estuarine habitats
- Community stability / human well-being
- Recreation / tourism

Climate-related stressors and potential climate change impacts

- Climate change
- Infrastructure development
- Energy development
- Invasive species
- Sea level rise
- Ocean acidification
- Ocean current changes
- Food web dynamics
- Phenological mismatches
- Disturbed regimes
- High sensitivity to land-sea interactions
- Global economic dynamics

Future Modeling Efforts

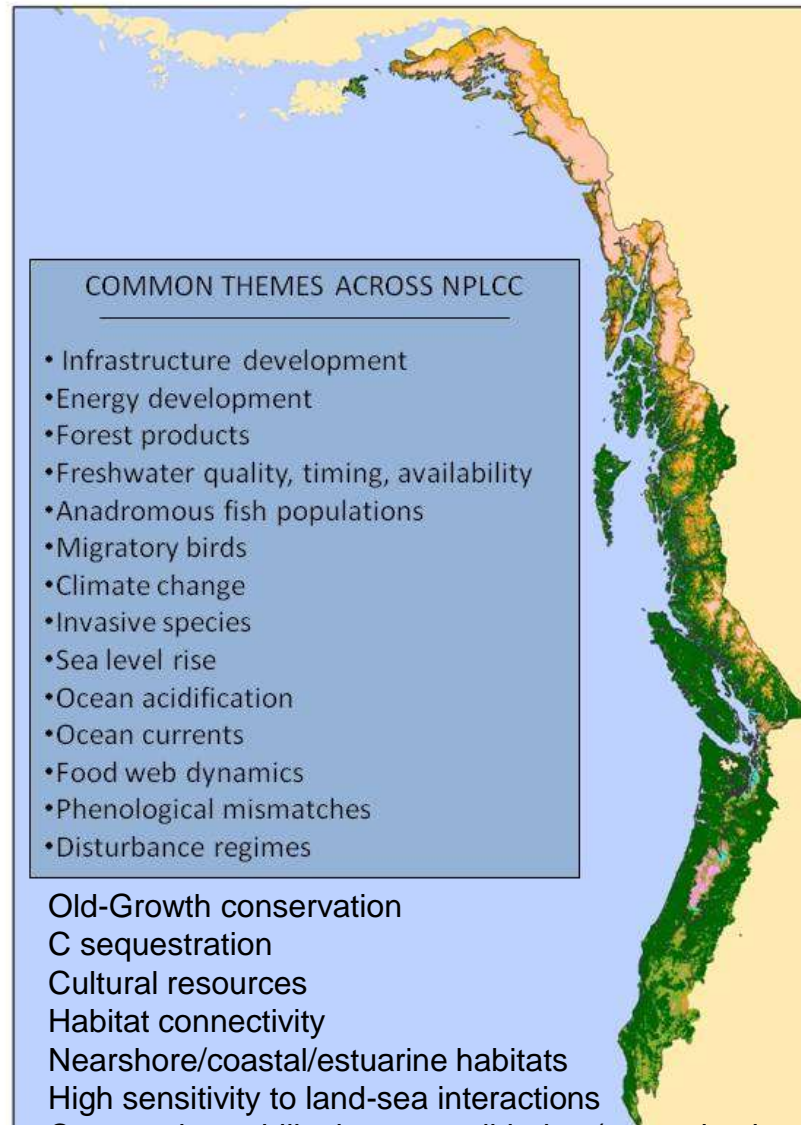
- Model linkages among ecological elements relevant to answering management questions
- Mechanistic description of ecosystem function
- Identify information gaps
- External communication – explain the NPLCC to others





COMMISSION FOR ENVIRONMENTAL COOPERATION
COMMISSION DE COOPÉRATION
ENVIRONNEMENTALE





Old-Growth conservation

C sequestration

Cultural resources

Habitat connectivity

Nearshore/coastal/estuarine habitats

High sensitivity to land-sea interactions

Community stability-human well-being (scenario planning tool is useful)

Recreation/tourism

Global economic dynamics



Many issues are cross-cutting – across traditional discipline boundaries

Omernik/Commission for Environmental Cooperation (CEC) Ecoregions

- Based on primarily soil, vegetation, landforms
- Depict major ecological areas the result from major ecological interactions
- Do not readily illustrate ecosystem dynamics
- Relative importance of parameters vary with area
- Boundaries bisect transition zones